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(54) Abstract Title

Apparatus for inflating vehicle tyre incorporating set pressure reading device

(57) The apparatus measures the tyre pressure 80, and optionally temperature 82 and controls actuator 86 to adjust the tyre pressure to a desired value. The desired value is input to the CPU 70 controlling the apparatus from a data reading device 50, which is preferably a barcode reader. The barcode 34 may be located on the valve cap or valve stem 28 as shown, or on a data card. The system may produce an alarm when the change of tyre pressure required exceeds a predetermined value.

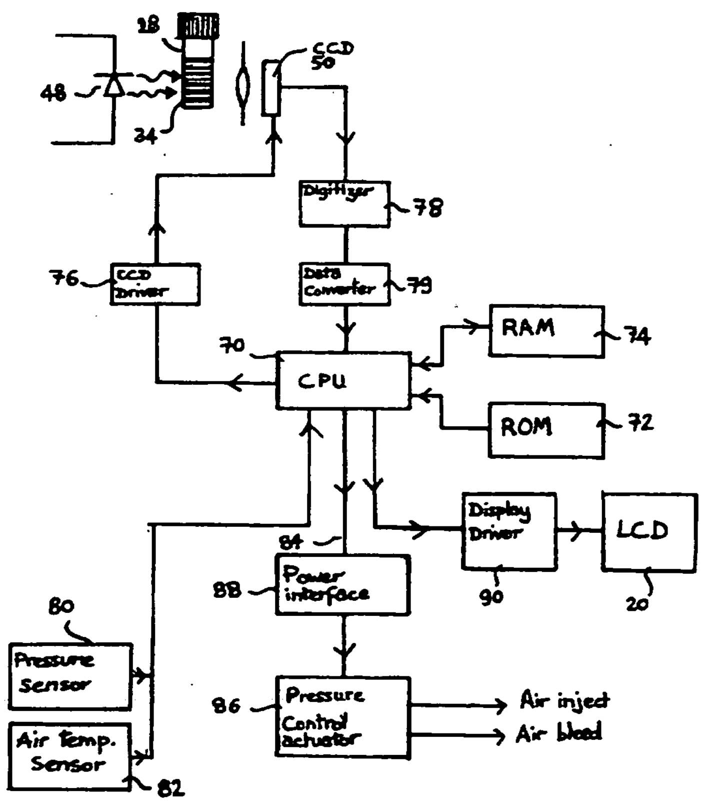

Fig. 10

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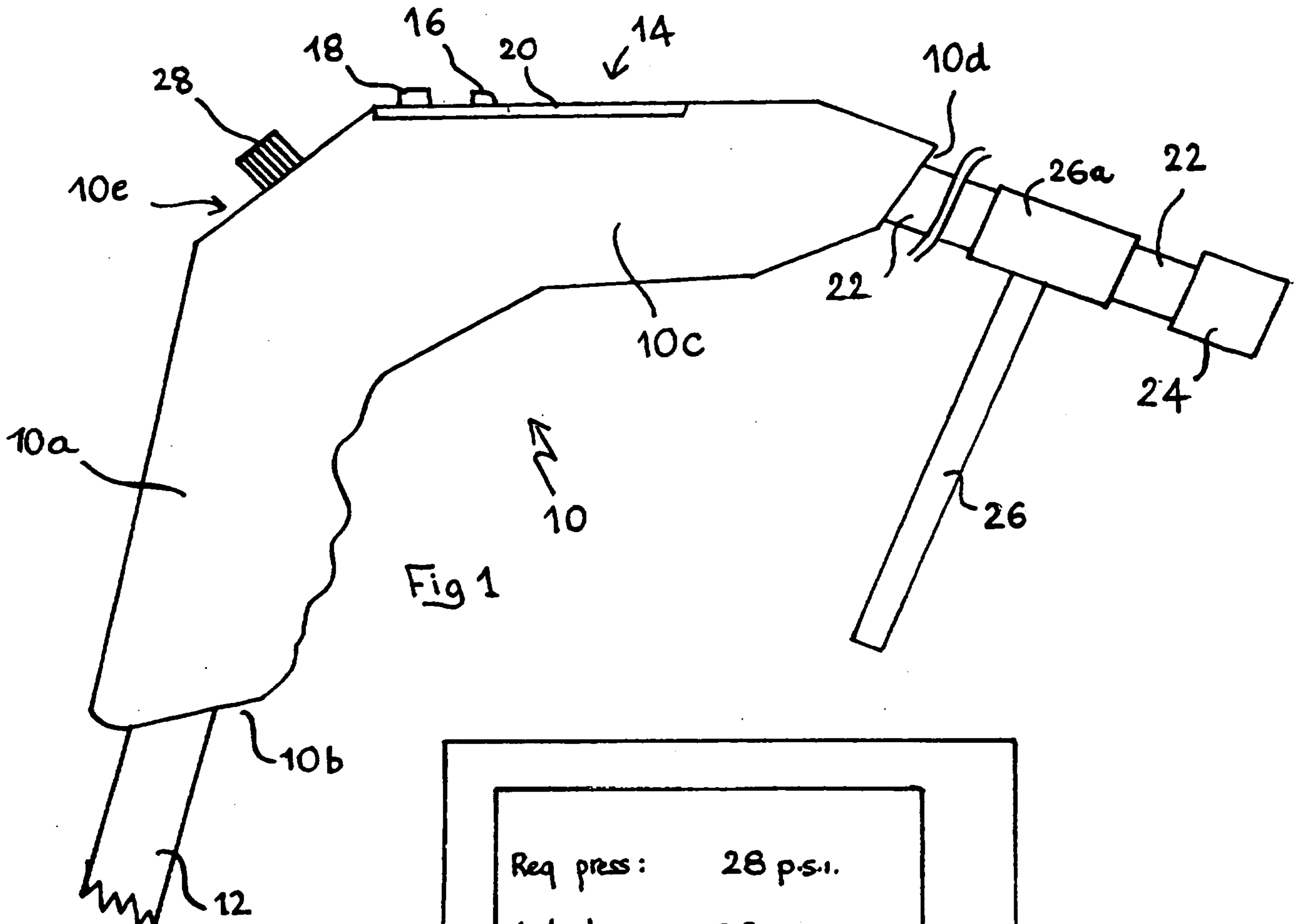


Fig 1

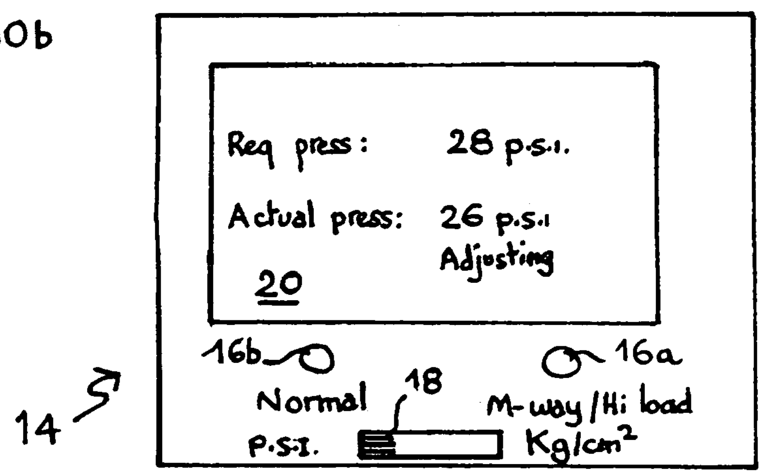


Fig 2a

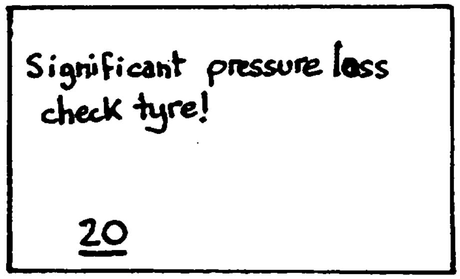


Fig 2b

Fig.3

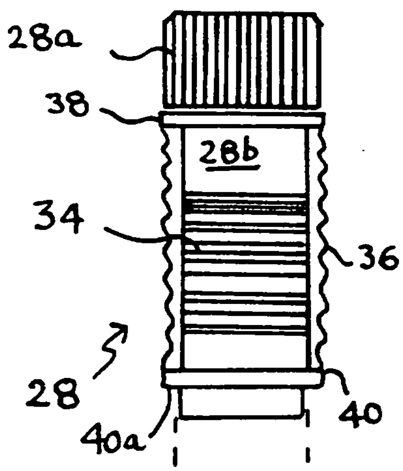


Fig.4

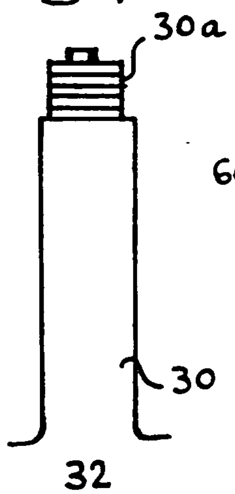
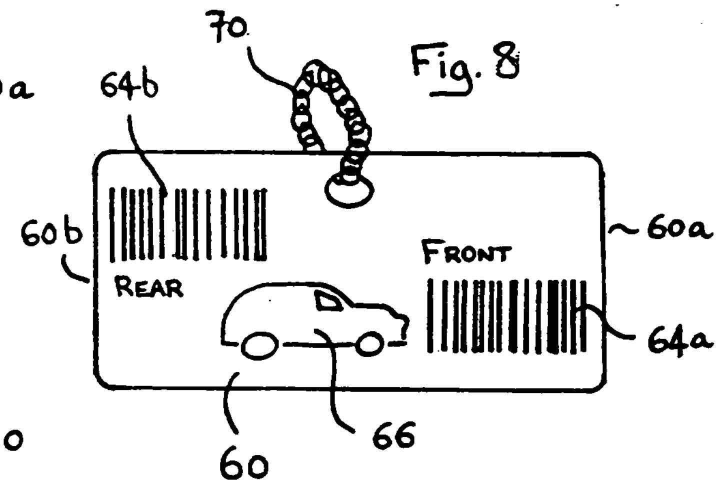


Fig. 8



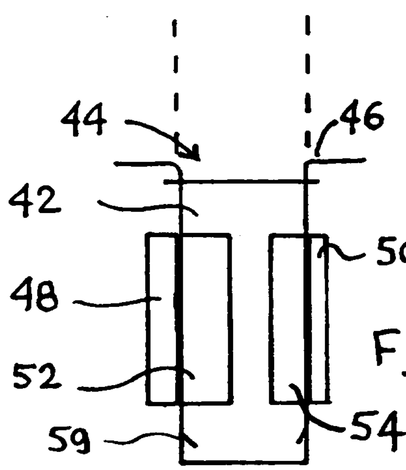


Fig.5a

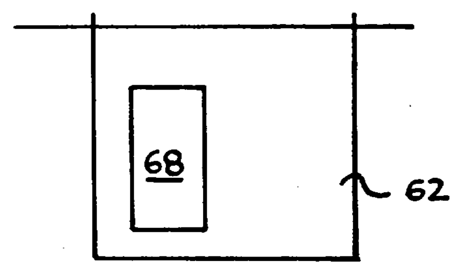


Fig. 9

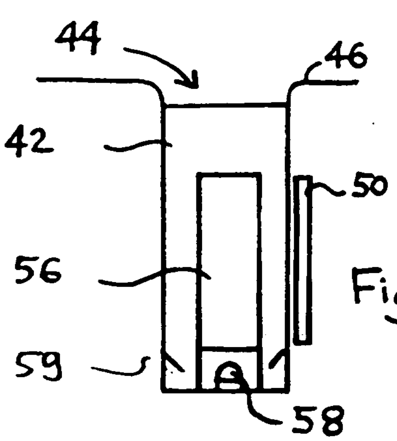


Fig. 5b

Fig. 6

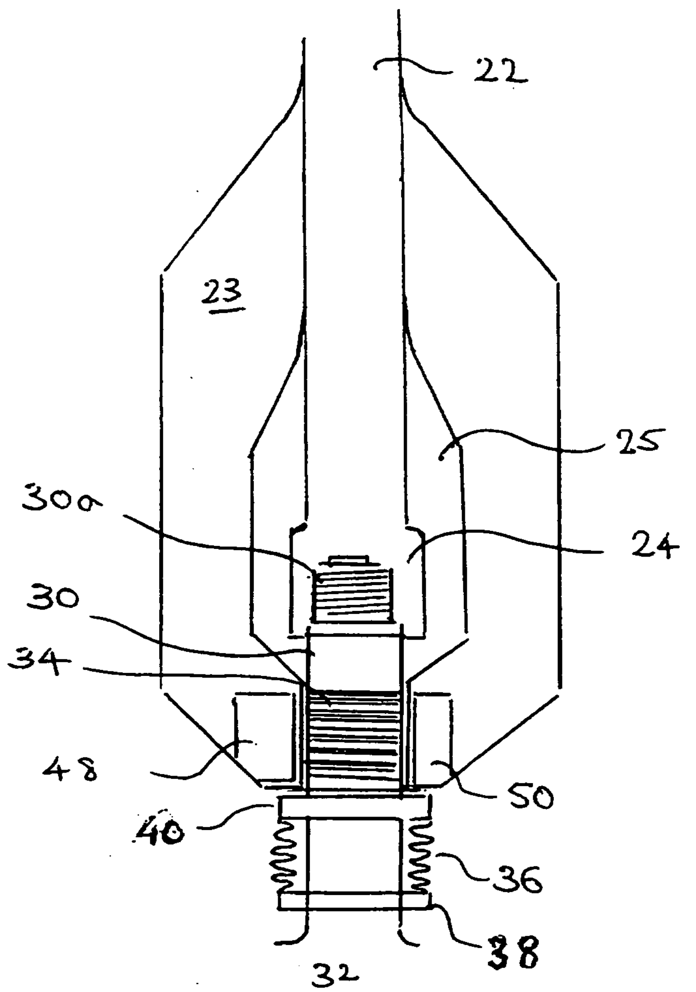
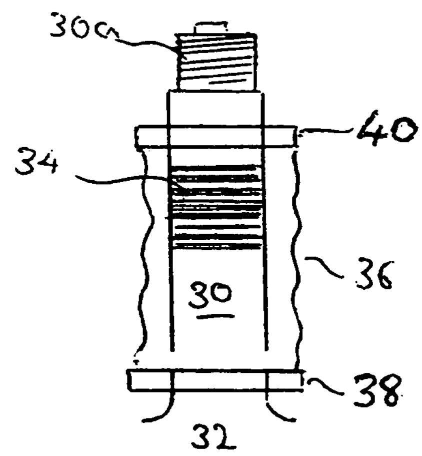


Fig 7



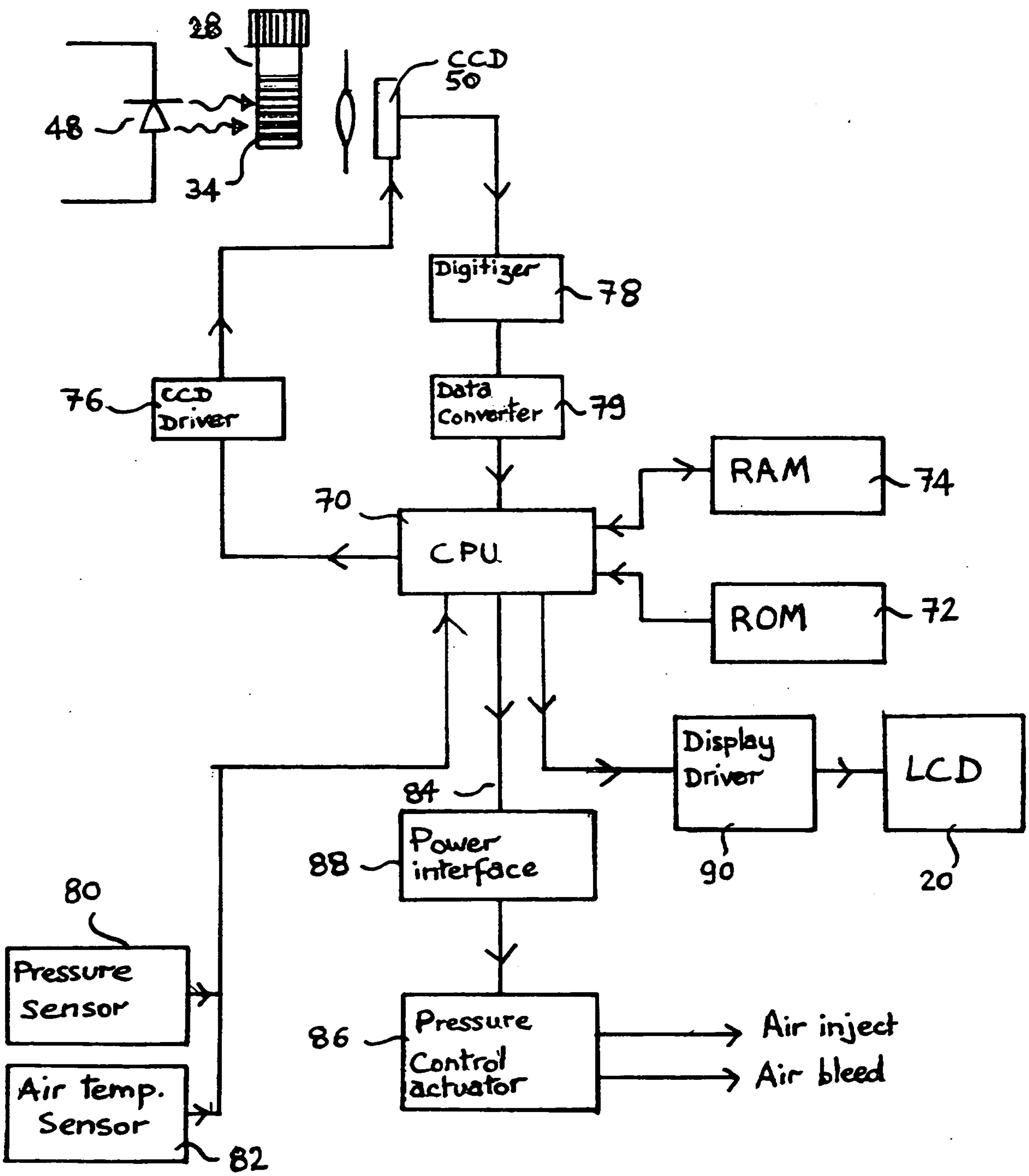

28
CCD
50
48
34
Digitizer
78
76
CCD Driver
Data Converter
79
RAM
74
70
CPU
ROM
72
Display Driver
LCD
84
88
Power interface
90
20
80
Pressure Sensor
86
Pressure Control actuator
Air inject
Air bleed
Air temp. Sensor
82

Fig. 10

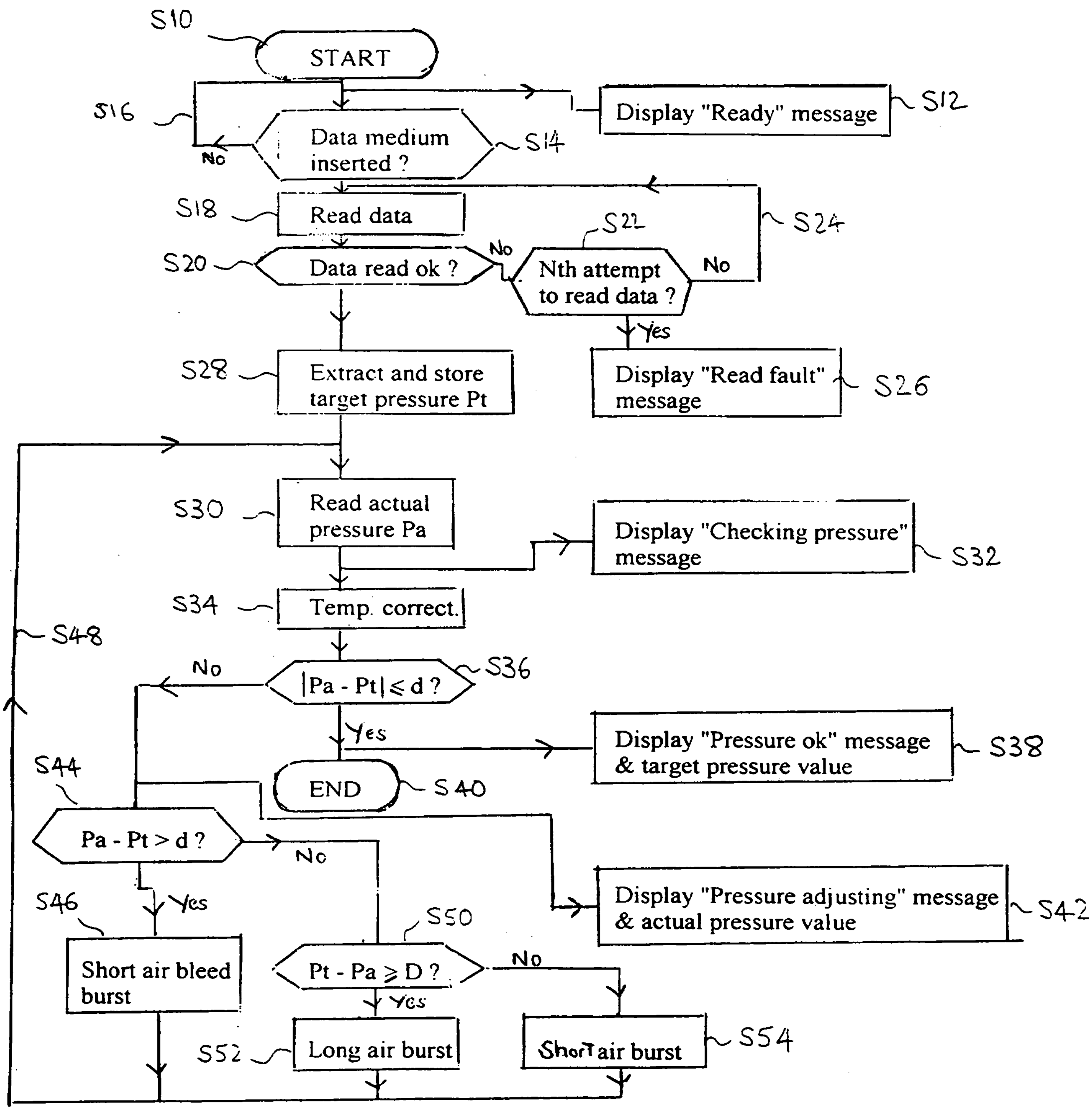

S10
START
Display "Ready" message
S12
S16
Data medium inserted ?
S14
No
S18
Read data
S24
S22
S20
Data read ok ?
No
Nth attempt to read data ?
No
Yes
S28
Extract and store target pressure Pt
Display "Read fault" message
S26
S30
Read actual pressure Pa
Display "Checking pressure" message
S32
S34
Temp. correct.
S48
No
|Pa - Pt| ≤ d ?
S36
Yes
Display "Pressure ok" message & target pressure value
S38
S44
END
S40
Pa - Pt > d ?
No
Display "Pressure adjusting" message & actual pressure value
S42
S46
Yes
S50
Short air bleed burst
Pt - Pa ≥ D ?
No
Yes
S52
Long air burst
Short air burst
S54

Fig. 11

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Automated inflation control device e.g. for vehicle tyres, inflation apparatus using said device and data carrier therefor.

The present invention relates to an automated inflation control device, e.g. for vehicle tyres, an inflation apparatus using such a device and to a pressure data carrier adapted to cooperate therewith.

Classical tyre inflation apparatus of the type installed for instance in filling stations, motorway halts and the like comprise a pressurising system or a compressed air source and a pressure hose depending from the latter for delivering the pressurised air to an adaptor that fits into a tyre valve. The apparatus also include a user-operated pressure admission/exhaust device allowing the user to increase or decrease the tyre pressure, and a tyre pressure indicator gauge. These two items are usually grouped in a hand-held terminal head in the path of the pressure hose, close to the terminal adaptor. In some designs, the pressure admission/exhaust device and the tyre pressure indicator gauge are instead located at a fixed unit at the upstream end of the pressure hose.

To ensure that the tyre is set to the required pressure, the user must consult the vehicle manufacturer's recommended inflation values and activate the pressure admission/exhaust device until the pressure indicated by the gauge corresponds. This operation is repeated for each tyre.

It has been found that the aforementioned type of inflation apparatus suffers from a number of drawbacks.

Firstly, it is important for the vehicle's stability that the tyres on the same axle be inflated as accurately as possible to the same pressure. However, many users fail to achieve this condition. This can be either because they do not read the pressure gauge accurately, e.g. owing to parallax errors, poor lighting conditions or visual impairment, or because they do not make the fine adjustments necessary once an approximately correct pressure has been set.

Secondly, the adjusting operations are fastidious and time consuming, with the result that users are tempted to omit to regulate their vehicle tyres at frequent intervals.

Finally, users driving vehicles with which they are not familiar often do not know the correct inflation pressure.

It can also happen that changes in tyre technology or modifications brought to the vehicle result in that the inflation values according to the vehicle manufacturer's original specification are no longer accurate.

It is therefore an object of the present invention is to provide an inflation control device that contributes towards improved safety by overcoming the above drawbacks.

According to the above invention, this object is achieved by a control device for an inflation apparatus of the type having an air

pressure source associated with air delivery means connectable to an inflatable object, comprising :

- air flow enabling means for selectively allowing admission of air into the inflatable object ; and
- air pressure sensing means for determining the pressure inside the inflatable obect ;

characterised in that it further comprises :

- data reading means for reading data from a data source,
- pressure determining means for obtaining a target pressure value on the basis of data obtained from said data reading means, and
- pressure adjusting means cooperating with said air flow enabling means and said pressure determining means for causing the air pressure of said inflatable object to be set on the basis of the inflation data read by said data reading means.

The present invention also aims to provide a data carrier characterised in that it contains coded data in a form readable by the present control device. The data can be a bar code provided on a carrier in the form of a specially adapted valve cap, or it can be provided on - or in the immediate vicinity of - the valve stem of the inflatable object. In the latter case, the data reader can form a combined unit with the inflation nozzle so that the data can be read whilst the nozzle is operatingly engaged with the valve.

Alternatively, the data carrier can be in the form of a card.

Finally, the present invention relates to an inflation apparatus comprising a compressed air source, means for delivering compressed air from the source to an inflatable object, and the above control device.

The dependent claims define preferred optional aspects of the present invention.

The invention shall be better understood and its advantages shall become more apparent from the following description of preferred embodiments, with reference to the appended drawings in which :

Figure 1 is a simplified side view of an inflation control device according to a first embodiment of the present invention;

Figure 2a is a diagrammatic representation of the control panel in the device of figure 1;

Figure 2b is a diagrammatic representation of the display in the control panel of figure 2a, indicating a warning message;

Figure 3 is a simplified side view of a data carrier in the form of a valve cap for use with the device of figure 1;

Figure 4 is a side view of a classical tyre valve stem for which the valve cap of figure 3a is adapted;

Figure 5a is a simplified sectional view of a receptacle and associated data reading means for the data carrier of figure 3;

Figure 5b is simplified sectional view of a receptacle and associated data reading means for the data carrier of figure 3 according to a variant of the first embodiment;

Figure 6 is a simplified sectional view of a terminal head combining a nozzle and code reader according to another variant of the first embodiment;

Figure 7 is a side view of a tyre valve stem adapted to form a data carrier suitable for the terminal head of figure 6;

Figure 8 is a front view of a data carrier in the form of a card, according to a second embodiment of the invention;

Figure 9 is a simplified sectional view of a receptacle and associated data reading means for the data carrier of figure 6;

Figure 10 is a block diagram showing the main functional means of the control device according to the first or second embodiment; and

Figure 11 is a flow chart showing the operation of the inflation control device according to the invention.

Referring to figure 1, the inflation control device is housed in a generally L-shaped body 10 located near the downstream end of a pressurised air delivery hose 12. A vertical section 10a of the housing constitutes a shaped hand-grip enabling the device to be held like a pistol. Its end portion 10b receives the pressurised air delivery hose 12 from a compressed air source (not shown).

A lateral portion 10c of the body is provided on its top surface with a control panel 14 (figures 2a, 2b) comprising selector buttons 16a, 16b to choose between whether the tyre is used in normal or motorway/high load conditions, and a slider switch 18 to set the pressure units : psi or kg/cm^2. The control panel 14 also includes a liquid crystal display (LCD) panel 20.

The end portion 10d of the lateral section 10c is fitted with a short air pipe 22 terminated by a nozzle 24 adapted for a vehicle tyre valve. The air pipe 22 (shortened in the figure) can be flexible or semi-rigid and appropriately shaped for easy insertion of the nozzle 24. In the example, a handle 26 is mounted on the air pipe 22 to help the user to orient and insert the nozzle 24 without having to touch the latter or the valve. The handle 26 is preferably slidable along the air pipe by means of a sleeve section 26a, but with sufficient friction to ensure easy handling. The handle 26 can thus be used for flexing the pipe 22 into the correct orientation as well as for pushing and maintaining the nozzle 24 into the valve.

The housing 10 also comprises an intermediate section 10e which is provided with a receptacle for a data carrier, the latter being in the form of a specially adapted valve cap 28 that is insertable by the user. As shall be explained in more detail, the data carrier 28 contains inflation information that is readable by the pressure control device for automatically adjusting the tyre pressure to the required value.

Referring to figure 3, the valve cap 28 forming the data carrier according to the first embodiment of the invention is in the form of an elongate cylindrical body. The top portion is comprised of a knurled head 28a whose inside surface is threaded for screw-mounting onto the tyre valve in the usual manner.

The remainder of the cylindrical body forms a tube 28b adapted to be insertable over the stem 30 portion of the tyre valve, between the valve head 30a and the tyre body 32 (figure 4).

The aforementioned tube 28b can have an internal diameter adapted to provide a snug, frictional fit over the stem portion 30. In this case, it may be possible to obviate the need for the head portion to be screw-mountable.

The outside surface of the tube 28b is provided with a bar code 34 which provides information readable by the inflation control device for ensuring that the tyre is inflated to the required pressure. In the example, the bars forming the code go round the entire circumference of the tube's outside surface.

At least the part of the tube's surface containing the bar code 34 is covered by a retractable shroud or sleeve 36. In the example, the sleeve 36 is a thin outer cylindrical plastics or elastomer element having accordeon-like folds or corrugations allowing it to adopt a compressed state by a stacking of the folds or corrugations in the manner of a bellows. One end of the sleeve is attached to a peripheral ridge 38 formed on the tube 28b near its point of junction with the knurled head 28a. The other end of the sleeve 36 is terminated by a ring 40 having a lower bearing surface 40a. The ring is able to slide over the tube's outside surface as the sleeve evolves between its compressed and extended states. The internal surface of the ring 40 can fit snugly around the tube 28b and be made of rubber or foam, or any other suitable material. In this way, the ring 40 can wipe the tube's external surface during its travel, and thus provide a cleaning effect on the bar code 34.

In its rest position, the sleeve 36 is sufficiently extended to cover the bar code 34, and thereby protect it from the ingress of dirt.

As shown in figure 5a, the receptacle 42 in the housing 10 (figure 1) for the above valve cap 28 comprises an externally-accessible hole 44 having a diameter substantially corresponding to that of the tube 28b. The entrance to the hole 44 is surrounded by a circumferential ridge 46 adapted to confront the lower bearing surface 40a of the ring 40.

Accordingly, as the valve cap 28 is inserted into the receptacle 42, the protective sleeve 36 automatically retracts by the pressing of the ring 40 against the ridge 46.

The configuration in the example is such that knurled head 28a remains fully outside the hole 44 when the valve cap is inserted into its data reading position (figure 1).

The inflation control device is fitted with a LED illumination source 48 and a linear charge-coupled device (CCD) image sensor 50, both arranged around the receptacle 42 to constitute a bar code reader. The illumination source 48 and sensor 50 are angularly offset and located close to the receptacle wall. Light from the illumination source 48 is guided to the bar code bearing surface 34 of the valve cap 28 by internal reflection or a light guide 52. The sensing surface of

the CCD 50 can be arranged very close to the receptacle wall for near-direct contact reading without recourse to relay optics. To this end, the CCD 50 may be equipped with a fiber-optic faceplate 54. The technology of CCD-based bar code readers suitable for the present application is now mature and relatively inexpensive to implement.

Other arrangements are possible for the illumination source and the image sensor to ensure an optimal light distribution over the bar code and a sharp image of the light reflected therefrom on the photosensitive surface of the sensor.

For example, in the variant shown in figure 5b, the illumination source is in the form of a small light-emitting cylinder 56 coaxially disposed in the receptacle 42 and engageable inside the portion of the valve cap tube 28b bearing the bar code 34. The tube is in this case made of transparent or translucent material. The cylinder 56 be made of glass or plastic with a frosted surface. It is illuminated from a bottom end by a LED 58 so as to function as a self-luminous source.

The circular geometry of the bar code 34 has the advantage of allowing the valve cap 28 to be inserted in any angular position around its principal axis. However, it can be envisaged to provide the outer surface of the tube 28b with one or a number of flat, longitudinally extending facet(s) on which the bar code is formed. The provision of the bar code on such a flat surface can be preferred inasmuch as it may allow the use of a simpler bar code reading device.

If a faceted bar code bearing surface is used, the inside surface of the hole 44 forming the receptacle 42 can be correspondingly faceted to ensure correct indexing of the bar code surface with respect to the reader 48-54.

The bottom portion of the receptacle is provided with electrical switch contacts 59 which turn the control device from a standby mode to an active mode automatically upon insertion of the valve cap 28 into its reading position.

The receptacle 42 may optionally be fitted with a mechanical catch or detent (not shown) to hold the valve cap 28 in the reading position with a light force, so allowing the user to release the knurled head 28a during operation.

Alternatively, spring means may be provided for constantly biassing the valve cap 28 away from the reading position so that constant pressure is required by the user. The spring means can in this case be constituted at least in part by the corrugated or accordeon shaped sleeve 36, if the latter is made of suitably resilient material. The constant bias can be preferred to provide the user more direct control of the device. It can further help prompt the user not to forget the presence of the valve cap - and hence to replace it on the tyre valve when checking the final tyre.

Figures 6 and 7 show a terminal head of the control inflation control device according to a variant of the first embodiment. For

simplicity, like elements of the figures 1 to 5 shall be given the same reference numerals in figures 6 and 7.

According to this variant, the bar code 34 is located on the tyre valve stem 30. In order to read the bar code, the nozzle portion 24 of the pressure control device is prolonged by a generally cylindrically shaped housing 23 containing the bar code reader. The cylindrical housing has a central cylindrical bore 25 designed to be received by the valve 30a and a substantial portion of the of the valve stem 30. The top part of the bore receives the air supply pipe 22 and encloses the nozzle portion 24 for insertion into the valve 30a as in a classical pump. The part of the inner wall of the bore which confronts the bar code surface on the valve stem is equipped with a LED light source 48 and a CCD image sensor 50 arranged in accordance with normal design practice to read the bar code.

The cabling for the electrical supply to the bar code reader and for the exchange of data can be physically associated with the air pipe, e.g. located within a weatherproof sheath surrounding the latter.

A protective sleeve 36 analogous to that shown in figure 3 can be provided on the valve cap stem 30 to ensure protection against the ingress of dirt. In the example, the sleeve 36 is fastened at one end to a ring 38 which is itself attached to the stem 30 at a portion near the tyre wall 32. The other end of the sleeve 36 is fastened to a ring 40 analogous to that of figure 3 bearing the same reference numeral, so as to be slidable over the bar code 34 on the valve stem 30 and effect a wiping action thereon.

Alternatively, the bar code 34 on the stem 30 can be protected by the provision of a valve cap having a covering sleeve section.

The bar code on the valve stem can be produced simultaneously with the tyre according to a predetermined protocol, or it may consist of an adhesive label applied at a later stage.

In the above example, the bar code 34 is directly on the valve stem 30. However, it is possible to have the bar code on a physical carrier that fits onto the valve stem, e.g. to provide a larger surface area for reading the code. Such a carrier can be permanently sealed on the valve stem, or it can be fitted as an accessory, e.g. by a snap-fitting device. The physical carrier can be in the form of a cylindrical sleeve element that fits around the valve stem, or an element presenting a bar code surface perpendicular to the valve stem axis, the bar code reading arrangement around the nozzle being adapted accordingly. In the latter variants, dirt protecting means may also be added. These can be based on the same bellows type sleeve as in figures 3 and 7, or on any other type of arrangement : sliding, hingeable or removeale covers, bushings, etc.

The physical carrier can also be positioned in the immediate vicinity of the valve stem.

Figure 8 shows a data carrier in the form of a card 60 according to a second embodiment of the invention. In this case, the inflation

control device shown in figure 1 is adapted to accommodate a slot-like receptacle 62 for the code reader 68, shown in figure 9.

The card 60 is provided with two coded data areas 64a, 64b on a common face, respectively containing information concerning the inflation of the front and rear tyres of the associated vehicle. Indicia 66 are provided on the card to indicate the leading edge 60a or 60b to insert into the receptacle 62 for reading the desired data area 64a or 64b.

The information in the data areas 64a or 64b is in the form of bar codes. The two data areas are arranged to be located at the same position and orientation when in the receptacle 62, so as to be readable by one same bar code reader 68. In the example, the card 60 is attached to a small chain 70 for fixing e.g. to a key-ring.

The main functional aspects of the control device according to the above first and second embodiments of the invention shall now be described with reference to the block diagram of figure 10.

The control device is centered around a microprocessor having a central processing unit 70 (CPU) which selectively reads a computer program stored in a read-only memory 72 (ROM). The CPU 70 also exchanges writable and erasable data with a random-access memory 74 (RAM) in accordance with a classical micocomputer architecture.

For reading the bar code information, the CPU commands a CCD driver 76 to send the necessary drive clock and control signal to the CCD 50 for an image scan. The analogue readout signal from the CCD is sent to digitizer 78 where it is converted into a formatted digital form representative of the bar code information. The digital signal is then sent to a data converter 79 which interprets the bar code information and extracts therefrom the necessary control and parameter data in a form readable by the CPU 70.

Depending on the pre-established protocol used, the coded information can comprise a numerical value that corresponds to the desired pressure value (target pressure value) and - optionally - the pressure differences between normal and motorway/high-load use and/or temperature correction values.

Alternatively, the information in the bar code 34 can comprise coded information that specifies the vehicle type : make, model and possibly vintage, as well as data specifying whether the associated tyre is at the front or rear. The code may also contain additional information such as whether the tyre is of a special type (e.g. a snow tyre or a thin-profile tyre).

In this case, the corresponding code is fed by the CPU 70 into a first pre-programmed look-up table stored in the RAM 74. The first look-up table contains the correspondance between the vehicle identification data and the tyre pressure inflation data. It will be understood that when the inflation data is in this way derived through the use of the first pre-programed look-up table, the data carrier shall nevertheless be considered as "containing inflation data".

The CPU 70 also receives data signals from a pressure sensor 80 which measures the actual pressure 82 in the tyre upon request and - optionally - from an air temperature sensor 82 which measures the temperature of the air inside the tyre for applying a temperature compensation for the tyre inflation, if required.

Additional data is supplied to the CPU 70 through the user-accessible selector buttons 16a, 16b for specifying whether the tyre is used in normal or motorway/high load conditions and the switch 18 for selecting the pressure units : psi or kg/cm^2 to be displayed. The CPU sends command signals via an output bus 84 to an electrically operated pressure control actuator 86 via a power interface unit 88. The pressure control actuator 86 is functionally connected in the path of the air supply line between the air pressure source and the air delivery pipe. It comprises a first electrically operated valve for commanding a burst of compressed air to the supply pipe 22 and a second electrically operated valve for commanding a burst of air to be bled off from the tyre. Such actuators are well known in the art and shall therefore not be described in detail.

The air temperature sensor 82 in the embodiment operates in conjunction with the second, air bleed, valve. Upon request for a temperature measurement by the CPU 70, the second air bleed valve causes a sample quantity of air in the tyre to to bled off to an air measurement chamber in the sensor. The chamber can be directly in the path of the delivery pipe 22, or in a diverted path using a classical valve-operated device for diverting the air flow during the temperature measurement operation. The temperature of the air thus collected is determined either by means of a thermocouple, a semiconductor device, a temperature sensitive resistor or a thermal infrared probe.

The CPU 70 also generates all the necessary information data to a display driver 90 for generating an appropriate visual indication on the liquid crystal display 20 (LCD) constituting part of the control panel 14 (figure 1).

The above functional units may be either all contained in the housing 10 of the control device. Alternatively, the power interface 88 and the pressure control actuator 86 can be located in a separate unit, e.g. at the air pressure source (upstream end of the air delivery hose).

The electrical power supply to the control device can be in the form of a rechargeable battery in the housing 10. In this case, the housing can be provided with external contacts for recharging the battery when in a stored position at a receiving unit equipped with a battery charger.

Alternatively, the functional units in housing 10 can also be powered from a supply cable depending from the pressurised air unit. The supply cable can in this case be formed so as to run along the air delivery hose 12 e.g. by being embedded under an outer covering of the hose 12.

The operation of the inflation control device according to the first or second embodiment of the invention shall now be described wih reference to figure 11.

Starting from the normal standby state S10, the LCD 20 displays a "ready" message S12. In this state, the controller executes a loop S14, S16 to detect the presence of a data medium.

Once the data medium is present, the code reader (collectively, the illumination source 50, CCD driver 76, digitizer 78 and data converter 79) is activated (S18). A subroutine (S20-S24) is then executed for carrying a predetermined number (N) of attempts at reading the data from the data medium. If no success is obtained after the N attempts, the LCD displays a "read fault" message (S26).

Once the data is read correctly, the CPU 70 extracts and stores therefrom the target pressure value Pt (S28). As explained above, this pressure value is obtained either directly or by reference to the first look-up table.

Next, the CPU 70 commands the air pressure sensor 80 to read the actual pressure Pa in the tyre (S30). At this stage, the LCD 20 displays a "checking pressure" message (S32).

At the same time, the CPU also reads the user-entered data concerning the choice of display units and whether the tyre is to be used in normal or motorway/ high-load conditions. In the latter case, the target pressure Pt is incremented in accordance with pre-specified recommendations. The amount of this increment can be fixed, given that it is substantially the same for the vast majority of vehicle tyres. However, for extra accuracy, the increment value for motorway and high-load conditions can be contained in the data on the data carrier or in the first look-up table.

The following step (S34) is optional and consists of determining the air temperature of the tyre by means of the air temperature sensor 82. Depending on the sensed temperature value, the controller applies a correction to the target pressure Pt. Specifically, it increments the target pressure value with the sensed temperature. The amount of the increment is determined from a second look-up table stored either in the ROM 72 or in the RAM 74, and can be fixed in accordance with groups of temperature values. For instance, the second look-up table may give the following correction information : 20-25°C - increment = 0 ; 26-30°C - increment = 1 psi ; 31-35°C - increment = 2 psi , etc. Different second look-up tables may be used depending the type of tyre or vehicle, as determined e.g. by the first look-up table.

Next, it is determined (S36) whether the difference between the actual pressure Pa and the target pressure Pt (taking into account possible temperature correction) is within an amount d which corresponds to a maximum acceptable discrepancy. If this is the case, then no change is made to the tyre pressure and the LCD displays a "pressure ok" message (S38). The control operation thereby ends (S40) and the control device then returns to the start state (S10).

If it is determined (at stage S36) that the difference between the actual pressure Pa and the target pressure Pt exceeds the maximum acceptable discrepancy d, the LCD displays a "pressure adjusting message" (S42).

If the actual pressure Pa is greater than the target pressure Pt (tyre over-inflated), the pressure actuator 86 is made to effect a short air bleed from the tyre by means of the second, air-bleed valve (S44, S46). The process then loops back (S48) to the step (S30) of reading the actual pressure Pa and thus continues until the difference between the target pressure Pt and the actual temperature Pa falls within the limit d.

If the actual pressure Pa is less than the target pressure Pt (tyre under-inflated), it is then determined whether the difference in pressure Pt - Pa is equal to or greater than a value D (significantly greater than d) which is an arbitrary threshold (S50). If the above difference is equal to or greater than D, the pressure controller is made to effect a relatively long air inflation burst into the tyre (S52), by acting on the first electrically controlled valve over a first time period.

Optionally, in the case where it is detected that the difference is greater than a safety threshold value (exceeding the value D), the CPU can order the issue of an alarm signal - audio or on the LCD display - to warn the user that the tyre was under-inflated to a serious degree.

More generally, if the data carrier is of the writable type (chip card, magnetic strip, etc.) there can be provided means for exchanging with the carrier data indicative of one or more of the following parameters :

- the date of a current inflation operation and the date(s) of (a) previous inflation operation(s); and
- the initial air pressure of said inflatable object at a current inflation operation and of (a) previous inflation operation(s);

The process then loops back (S48) to the step (S30) of reading the actual pressure Pa and thus continues until the difference between the target pressure Pt and the actual temperature Pa, falls within the limit d.

If the above difference is less than the threshold value D, the pressure controller is made to effect a relatively short air inflation burst into the tyre, by acting on the first electrically controlled valve over a second time period shorter than the first time period (S54). The process then loops back (S48) to the step S30 of reading the actual pressure Pa, and thus continues until the difference between the target pressure Pt and the actual temperature Pa falls within the limit d.

After the loop back (S48) to the step S30 of reading the actual pressure value Pa, the temperature correction step S34 can be omitted, given that the air temperature inside the tyre would have changed negligibly after the adjustment bursts.

The quantities chosen for the air bleed, the long air inflation burst and the short air inflation burst are adapted to the threshold

value d so as to avoid the risk of endless loop conditions, and to ensure that the adjustment process comes to an end. The typical number of loop-backs involved can be kept reasonable by an appropriate selection of the above parameters.

The automated inflation by means of an external data carrier in accordance with the present invention paves the way for many additional features and variations whilst remaining within the scope of the claims, and of which some shall now be briefly outlined.

The external data carrier can take a variety of other forms. It may, for instance, be a label adhered to the wall of the tyre or on the vehicle in the vicinity of the tyre. In this case, the data reading means can be implemented by an appropriate scanning device (e.g. a hand-held bar code reader).

In all cases, the data reader of the control device need not be located in the housing 10 or at the end of the air supply pipe 22. It may, for instance, be at a fixed unit upstream of the air delivery hose.

The coded data need not necessarily be in the form of a bar code. Any other suitable information encoding technology can be used for this purpose, amongst which are : semiconductor memories, magnetic media, passive or active tuned circuits having coded resonant frequency characteristics, transponders inside the tyre, mechanical encoding means (keys, bumps, etc.) and any other form of optical encoding.

It is also possible to implement the invention with a data carrier that can receive and store data from the air pressure control device. This information can relate to a number of parameters, such as the date of (a) previous check(s), the initial (before adjustment) actual pressure value(s) measured at the previous check(s), etc. This data can be read by the CPU and serve to deduce information relating for instance to the frequency of tyre pressure checks, or the rate of loss of pressure, and to display a corresponding warning message on the LCD display. For example, the display message shown in figure 2b warns the user that a significant pressure loss occured since the last pressure check, and that the tyre condition should be checked. Other messages can invite the user to check the tyre pressure more frequently, if the detected elapsed time since the previous check exceeds a predetermined limit.

It shall also be noted that the described embodiment is based on a software controlled pressure adjusting system with several feedback loops. However, the present invention can also be implemented with known pressostats that can be mechanically set to a chosen target pressure. In such a case, the reading means can be made to act on mechanical setting of the pressostat.

Naturally, the present inflation control device in all of its forms can be equipped with the usual manual controls for applying or bleeding air pressure so that it can be used just as any other form of classical pump. The manual controls can also be useful to provide an

override function, e.g. if a user wishes to set the pressure to a personally-chosen value.

Finally, although the embodiment is directed to a vehicle tyre inflation control device, the invention can be used in fields involving other inflatable objects requiring carefully controlled pressure values : inflatable dinghies and craft, inflatable barriers, orthodpaedic appliances, and sports equipment etc.

Claims

1. Control device for an inflation apparatus, e.g. for inflating a vehicle tyre, of the type having an air pressure source associated with air delivery means connectable to an inflatable object, comprising :

- air flow enabling means (86) for selectively allowing admission of air into said inflatable object ; and
- air pressure sensing means (80) for determining the pressure inside said inflatable obect ;

characterised in that it further comprises :

- data reading means (48, 50) for reading data from a data source (34),
- pressure determining means (70-79) for obtaining a target pressure value (Pt) on the basis of data derived from said data reading means, and
- pressure adjusting means (88) cooperating with said air flow enabling means (86) and said pressure determining means (70-79) for causing the air pressure of said inflatable object to be set on the basis of the inflation data read by said data reading means.

2. The control device according to claim 1, wherein said data reading means (48, 50) comprises means for reading an external data carrier (28, 60).

3. The control device according to claim 2, wherein said external data carrier is physically associated with a valve cap (28) of said inflatable object.

4. The control device according to claim 2, wherein said external data carrier is physically associated with a valve stem (30) of said inflatable object

5. The control device according to claim 2, wherein said external data carrier is in the form of a data card (60).

6. The control device according to any preceding claim, wherein said data reading means comprises receptacle means (42; 62) for accommodating said data carrier (28; 60) and activating means for initiating said inflation control, said activating means being responsive to a presence of said data carrier in said receptacle means.

7. The control device according to any preceding claim, enclosed in a housing (10) proximal to the downstream end of a pressurised air delivery hose, said housing comprising parameter display means (20) and having, depending therefrom, an air supply pipe (22) equipped with a terminal adaptor (24) for connection to said inflatable object.

8. The control device according to claim 4, 6 or 7, wherein said data reading means is at a nozzle portion of said air delivery means and arranged for reading data from a carrier located at or in the immediate vicinity of a valve stem of said inflatable object.

9. The control device according to any preceding claim, further comprising alarm means for indicating when a pressure of said inflatable object detected by said air pressure sensing means (80) differs from the air pressure value read by said data reading means by an amount exceeding a predetermined value.

10. The control device according to any preceding claim, further comprising air temperature sensing means (82) for determining the air temperature of said inflatable object and compensation means for causing said pressure adjusting means to set the air pressure of said inflatable object further in accordance with said determined air pressure.

11. The control device according to any preceding claim, wherein said data reading means (48, 50) reads data in the form of code containing a desired air pressure value.

12. The control device according to any preceding claim, wherein said data reading means (48, 50) reads data in the form of a code containing an identification of said inflatable object and/or an object from which it depends, said device further comprising look-up table means establishing a correspondance between said code and a desired pressure value.

13. The control device according to any preceding claim, wherein said data is in the form of a bar code (34).

14. The control device according to any one of claims 1 to 12, wherein said data is in the form of a writable data carrier.

15. The control device according to any preceding claim, further comprising means for exchanging with said carrier data indicative of one or more of the following parameters :

- the date of a current inflation operation and the date(s) of (a) previous inflation operation(s); and
- the initial air pressure of said inflatable object at a current inflation operation and of (a) previous inflation operation(s).

16. The control device according to claim 15, further comprising means (24) for displaying a message on the basis of said parameters.

17. An inflation apparatus comprising a compressed air source, means (24) for delivering compressed air from said source to an inflatable object, and a control device according to any one of the preceding claims.

18. A data carrier (28; 60) characterised in that it contains coded data (34) in a form readable by a control device according to any one of the preceding claims.

19. A data carrier readable by the control device according to any one of the preceding claims, characterised in that it is in the form of a valve cap (28).

20. A data carrier readable by the control device according to claim 4, characterised in that it is the form of a device for fitting at or in the immediate vicinity of a valve stem (30) of said inflatable object.

21. A data carrier according to claim 19 or 20, further comprising dirt protection means (36-40) for covering a data reading surface (34) of said data carrier (28).

22. The data carrier according to claim 21, wherein said dirt protection means (36-40) comprises a hood (36) covering the data reading surface of the data carrier, said hood being retracted upon insertion of said valve cap (30a) into said data reading means (44).

23. A data storage card (60) characterised in that it comprises coded data (64a, 64b) readable by a control device according to any one of the preceding claims.

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Databases searched:

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Int Cl (Ed.6): B60S 5/04; G05D 16/00, 16/20.

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Category	Identity of document and relevant passage	Relevant to claims
X, Y	GB 2,214,678 A (JACKSON)	X: 1-4, 7-8, 11-13, 17, 19-21. Y: 5, 10.
X	WO 94/04398 A (ACKERMANN)	1-2, 17.
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X	FR 2,701,908 (ANNENCY ELECTRONIQUE)	1-2, 5-6, 11-13, 17.

X	Document indicating lack of novelty or inventive step
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